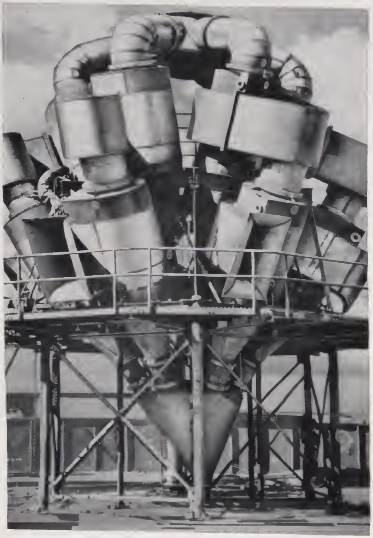
the Mecheleciv

VOL. 13 APRIL 1954 NO. 5

SCHOOL OF ENGINEERING
THE GEORGE WASHINGTON UNIVERSITY

Only STEEL can do so many jobs so well



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SCHOOL OF ENGINEERING, THE GEORGE WASHINGTON UNIVERSITY

IN THIS ISSUE

ON OUR COVER

Bob Gardner, Bernie Kilday and Paul Schmidt are investigating the characteristics of a multivibrator in the Electronics Devices Lab.

FRONTISPIECE

The world's largest capacity single-armature direct current motor is shown being readied for shipment. The 10,500 horsepower giant, together with its twin, is part of Westinghouse marine propulsion equipment soon to be installed in the U. S. Navy's newest and fastest icebreaker. The 8,600 ton icebreaker's motors will be powered by 10 diesel-driven 1700 kilowatt generators. The icebreaker will also feature electrical equipment to operate a heeling device that will enable the cutter to "rock" itself free of imprisoning ice, thus the ship will literally shoulder its way through an ice field.

—Courtesy Westinghouse Electric

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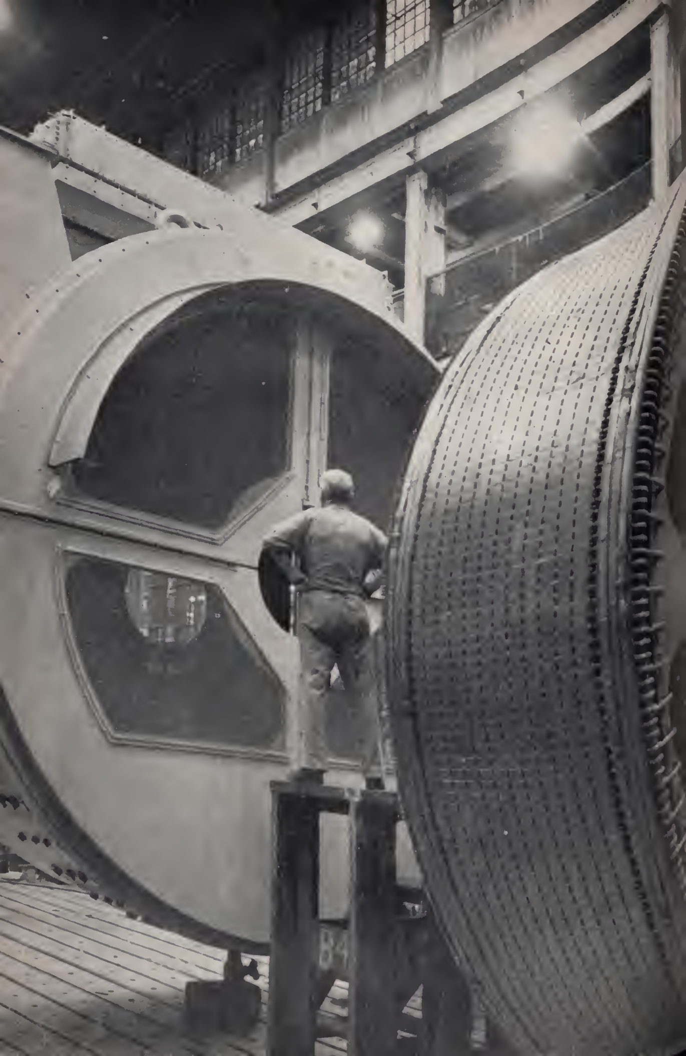

Next Year . . . ?

Within the next few weeks a newly elected Engineers' Council will begin planning for next year's activities. What they decide is of importance to the students, since they will be participating in these activities. The mixer, ball, banquet, and the Christmas Tree Lighting are but a few of these activities.

Whether you realize it or not, the Engineers' Council represents you, the student. Therefore, they should consider your suggestions about their activities. Perhaps you have thought about this already. Most everybody did after the Mixer last fall.

The unfortunate thing in the past has been that the Council has had to do most of its planning without the aid of the opinions of the student body, as a whole. They have had to guess what the other students want.

This situation need not be the case next year, and the Council hopes that it will not be. Every society and fraternity will hold at least one more business meeting this semester. At this meeting your Council Representatives will ask your society for ideas or suggestions for the Council to consider. This is not a new procedure, however. What would be new is that a large number of students give the matter some thought before hand.

We come then to the purpose of this editorial—to remind you of this assistance you may give the Council and yourself. Now then, what are some points to consider? Below are a few that have occurred to us. Consider these, see what you think of them, and maybe they will suggest more or better ones to you.

First, is the matter of the Engineers' Mixer. Should it be as it was last fall? How could it be improved? Other routine activities of the Council could be improved—The Christmas Tree Lighting, the Ball, the Banquet, the Career Conference.

Also, some additional activities could be considered. How about an Engineers' Queen next year? Should we enter a float in the Homecoming Parade next fall? Perhaps you might like to enter the intramural teams in the University athletic programs.

There are many ways the activities program might be improved, and it is so simple to do this there is no reason why it can't be. All you have to do is to give the matter some thought, talk it over with your friends, and mention it to your Council Representatives.

If the council activities are a result of what has been suggested, there is no reason why we can't be successful in everything we undertake next year.

Every Thing Changed But The Name

In EE 150 Electronic Devices Laboratory

By Robert H. Montgomery BEE '54

A course designated EE 150 and titled Electronic Devices Laboratory has been in the Communications Option of the Electrical Engineering curriculum for a number of years. However, this semester it has become almost an entirely different course. In previous years the student was responsible for twelve laboratory experiments. Starting this semester the number of experiments each student is responsible for has been cut to seven. Hold on, before you run to register for the course read how the course is now conducted compared to previous years.

In time gone by the experiment to be conducted by the student was either outlined for him by the instructor on mimeographed sheets or listed in the Laboratory Manual. The procedure to be followed was given as well as the equipment to be used. This often led to a student coming into the laboratory "cold" and using the Laboratory Manual as one would use a cook book or depending upon his partner(s) to run the experiment. In a situation such as this the student could perform the experiment, write up his report acceptably and still not derive much knowledge of what he did and why. Mind you, this example cited was a possibility, not the rule. In any case, the student was not put to think for himself to any great extent.

At the present time this course is under the direction of Mr. William Balwanz, a graduate of this University who received his Master's Degree from the University of Maryland. Mr. Balwanz is an Electronic Scientist at the Naval Research Laboratory by day and an Instructor at GW by night. Mr. Balwanz has redesigned the course to give an introduction to the methods of attack on new problems as practiced in many laboratories as well as giving the usual practice in the use of new equipment and the solution of engineering problems. The exercises assigned cover fields already thoroughly investigated, rather than those usually encountered in actual practice in which further knowledge in the field is desired, since the latter require more time than is available in this course.

Seven experiments are required of each student. Six of these experiments are the investigation of the characteristics of selected equipment. The student is allowed two laboratory periods to complete all measurements and observations for each experiment. The experiments to be performed are selected by the student with the approval of the instructor. The experiments assigned are such as to give the student a knowledge of a wide variety of electronic equipment and principles. For example, several experiments may require the use of a wave analyzer. It is required that the student perform one of these experiments in order to familiarize himself with this piece of equipment.

Prior to starting an experiment, the student must submit a preliminary report. This preliminary report should contain an introduction giving the historcal background if available, the importance of the subject to the field of electronics, and the relation of the tests to be conducted with respect to the particular equipment used. The theory involved must be presented in sufficient detail to justify the proposed experiment and the method of attack and proposed tests must be outlined. The preliminary repjort should correlate the proposed tests to the theory and show how the tests will prove or disprove the theory involved. In preparing the preliminary report it is required that at least three references be consulted.

The experiment investigation should be short enough to complete within one laboratory period yet sufficiently comprehensive to prove the desired points. All of this in so many words says that the student must know exactly what he wants to do, how to do it, and why he is doing it before entering the laboratory. The student may be called upon at any time to explain in a

five minute discussion how, and why he is running the tests that he is and what he hopes to accomplish. During the first laboratory period all proposed tests are to be completed. The second laboratory period is used to check on

Bob Klasse, left, and Joe Murdock, right receive a word of advice from Mr. Balwanz.

any discrepancies which appear in his calculations and data. Checks must also be made to give the limitations of the test equipment and any errors which may be introduced by such equipment. Although as many as three students may work together in a group each must prepare his own preliminary report and decide upon the experimental tests. The members of such a group can then decide from a comparison of proposed tests which tests will most likely yield the optimum results.

Before leaving the laboratory after completion of the second period, a method of attack for the next experiment is to be decided upon and selection of equipment made.

In the final report a logical explanation for all observed phenomena must be made and the theory must be correlated to the experimental results and any discrepancies explained.

The six experiments are to be chosen from the following:

1. Performance characteristics of a degenerative-type voltage regulator.
2. The effects of compensation upon the amplitude and phase response of a video amplifier.
3. The influence of load impedance upon the distortion and power output of power amplifiers.
4. Frequency and amplitude stability and the linearity of relaxation oscillators.
5. Performance characteristics of a balanced modulator.
6. The effects of inverse feedback on the performance characteristics of a voltage amplifier.
7. Performance characteristics of integrating, differentiating, clipping and pulse shaping networks.
8. Performance characteristics of multivibrator and trigger circuits.
9. Investigation of the method of square wave testing.
10. Characteristics of a thyratron trigger circuit.
11. Characteristics of a variable reactance tube.
12. Allignment, selectivity and sensitivity of a superhetrodyne receiver. (The student may use his own receiver if desired.)
13. Investigation of the transient response to an impulsive signal of a circuit containing inductance and capacitance.

The seventh experiment is one of construction, test and evaluation. It is selected with the approval of the instructor and must be sufficiently limited in detail in order that it may be completed on schedule. This experiment may involve construction of equipment for the laboratory in which case the University will furnish the parts or it may be construction of equipment for the student's personal use in which case the student furnishes the material. Upon completion of assembly, tests are to be made as far as the other experiments The

The writer, Bob Montgomery, prepares to photograph a transient.

reports must include schematic drawings, layout diagrams and parts lists. The final report is due at the final class meeting.

This new procedure in EE 150 puts more work upon the student but it also benefits him a great deal. He is required to think more and to an extent he has the responsibility of setting up a small test program. This procedure may also provide a stepping stone to what the student will encounter in the field after graduation.

NUCLEAR ENERGY LEVEL LIFE MEASUREMENTS

By Derrill C. Rohlfs, BEE '55

In 1948 George Washington University extended an invitation to Dr. Zoltan L. Bay, Professor of Atomic Physics at the Budapest Technical University in Budapest, Hungary, to come to the University as chief scientist in charge of a small laboratory which was to be set up for the purpose of conducting research and experiments in certain phases of nuclear physics. Dr. Bay accepted this invitation and, upon his arrival, was aided by the Office of Naval Research, the Bureau of Ships and the Atomic Energy Commission in setting up his laboratory. This was the beginning of a small but extensive research program.

With the very capable assistance of Dr. Vector Henri, Dr. Herbert Kanner, Mr. F. McLernon, Mr. B. Ziedman, Mr. L. Monostori and Mr. We Hara, four research projects are being carried on. They are as follows: (a) Time measurements of the life of the energy levels within an atom nucleus; (b) improvement of scintillation counters; (c) utilization of short-time measuring techniques for highspeed computing machines, and (d) research in mass-spectrometers.

In this article the time measurements of the life of energy levels within an atom necleus will be discussed.

It is known that matter is composed of molecules and that molecules are made up of atoms. These atoms consist of electrons, protrons and neutrons, the latter two make up the nucleus, the central portion of the atom. The project involves the measurement of time that an energy level exists in a nucleous. If a substance is radio-active, the nucleus of an atom will emit particles of alpha, beta, or gamma at different intervals of time. Between each of these emissions, the nucleus exists at an energy level. Just as an atom of hydrogen is characterized by its single electron, so is a substance characterized by the length of time that a nucleus exists at certain energy levels.

The time measurement of energy levels of nuclei is accomplished by a maze of special tubes, special circuits, amplifiers and counting circuits. Figure 1 shows a block diagram of how the experiment is set up. As you will note, there are three special functioning circuits in this electronic apparatus. A piece of radio-

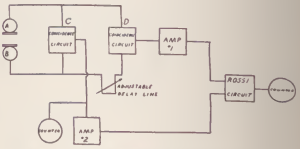

Fig 1 — Block diagram of apparatus set-up.

active material, such as cobalt 60, a by-product from the atomic pile, is placed between two specifically constructed electron multiplier tubes, which contain the scintillation[1] crystals. As a nucleus goes from one energy level state to another, sentillation occurs at the crystal. The electron multiplier tubes in turn change this scintillation into an electronic pulse. After passing through the electron multiplier tubes, the amplitude of the pulse is of sufficient value to operate the first circuit, which is of a high-speed coincidence design. (Figure 2) When a negative pulse occurs in channel A and no pulse in channel B, condensers C-4 and C-5 will be charged to approximately the same value and will be discharged through resistors R-7

[1] Scintillate: To emite sparks; in this case the sparks are microscopic in size.

and R-8. The resultant output pulse will be zero, if R-7 and R-8 have been properly balanced. If we have a negative pulse in channel B simultaneously with a pulse in

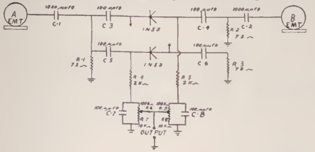

Fig. 2 — First high-speed coincidence circuit.

Channel A, the charge on C-4 will be less than that on C-5, and a difference of potential will exist in the output. This indicates coincidence scintillations only and are counted by special electronic counters. The output is amplified and applied to a Rossi circuit.

From the electron multiplier tubes the negative pulses are applied to the second special electronic highspeed coincidence circuit. (Figure 3) The operation of this circuit is similar to the previous one, except for the time delay lines. As in the first circuit, when a negative

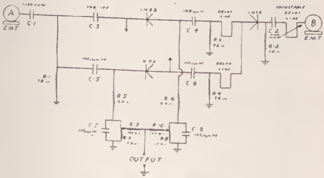

Fig. 3 — Second high-speed coincidence circuit.

pulse occurs in channel A and no pulse in channel B, there will be no output pulse. However, in this circuit, when a negative pulse occurs in channel A simultaneously with no time delayed pulse in channel B, there will be no output. Also, when a negative pulse occurs in channel A simultaneously with a time delayed pulse in channel B, an output will exist. This output is likewise applied to the Rossi circuit. The delay line is used to change the time that the artificial coincidence will follow the genuine coincidence, causing a lag. The output of the circuit is then connected to another amplifier from which it is applied to the Rossi circuit.

The Rossi circuit, which is the third special circuit (Figure 4), consists of two imputs and one output. When simultaneous pulses from the first coincidence circuit and the second coincidence circuit are applied to the Rossi circuit, the output will be of sufficient amplitude to operate the second counter.

As the cobalt 60 changes to nickel 60 (Figure 5), it goes through two energy states, O1 and O2. First, a beta particle is emitted, then two

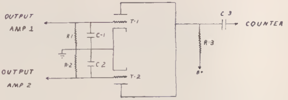

Fig. 4 — Rossi circuit.

gamma particles are emitted. When two coincident beta particles strike the scintillation crystals, the apparatus agan functions. A graph of the counts versus delay line time is plotted. This gives the relation of the time in the first energy level. If a beta particle absorber is used between the cobalt 60 sample and the scintillation crystal, the beta particles will therefore not operate the apparatus. But the two gamma particles will. Another graph of count versus delay line time is plotted. From these relationships the time existing at each energy level can be calculated.

Thus additional knowledge of the earth around us has been obtained and another step in our vast realm of knowledge has been taken.

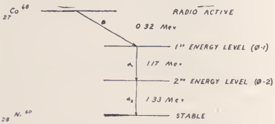

Fig. 5 — Energy level changes of Co 60.

Cobalt 60 was the first radio-active material to be used in this experiment, but from all indications it will not be the last from which the life of an energy level can be measured.

CAREER CONFERENCE NOTES

Published below are notes taken at the Engineering School Forum at the Annual Career Conference held March 31. This feature points up the major topics in each speaker's talk. MECHELECIV *thanks Mrs. Anne Chasen for her work in obtaining these notes*—ED.

The Engineering Career Forum met in the Hall of Government, Room 101, at 8:30 p.m. Mr. Herbert H. Rosen, President of the Engineers Council, opened the forum and introduced the speakers for the evening.

The first speaker, Mr. Ralph L. Goetzenberger, Vice-President of Minneapolis-Honeywell, discussed "The Engineer in Manufacturing Industries."

The professional engineer is one who adapts the materials found in nature to a more useful form and aids nature to do man's work. He makes this adaptation at a cost—which usually his client must pay. The engineer must be scientific, imaginative and creative, in fact, creativeness is the main spring. To these qualities must be added a good, general education, accuracy, and the capacity to get along well with other people.

What is the nature of the engineer's work in various manufacturing fields? Administration: 34% of all engineer rise to positions where they direct the work of others. 40% of all industrial leaders are engineers, men who have to deal with human problems and business deals. Usually these engineers earn the highest salaries. Planning and Design: These engineers lay the ground work for producing machines, structures, water supply systems, transportation, etc. They draw plans and specifications. They watch costs in building and are concerned with the operations in building machines. Sales: In order to sell an engineering product, you must be able to speak the language of the engineer. You must know what to recommend to your customer in order to fill his particular needs. It is, therefore, absolutely necessary to know how to meet and deal with people. Construction and Installation: Here the engineer turns plans into reality. Production and Operation: 7% of all engineers operate in this field. Factories are directed by men who know technical details, know how to operate crews, and study how to improve. Research and Development: Finding new ways to do things or develop or improve methods already known is the responsibility of about 18% of all engineers. Teaching: This is probably the most important part in turning out successful engineers. Mainly it involves acquainting men with the products and problems that will confront them when they get jobs. Engineering work requires mental rather than physical dexterity. To make a good engineer requires a good basic foundation of mathematics, the sciences, and economics, together with active curiosity, the love of study, knowing how to put your knowledge to use, and being cost conscious.

How does the engineering graduate go about getting a job? Many firms make a practice of interviewing students, or whole classes of students, before graduation and make offers to those whom they feel are qualified. Most universities have employment or placement offices. Newspapers of good reputation are often utilized, and writing to the place where you would like to be employed is also a legitimate way of seeking employment.

The basis for selecting engineers is as follows: 1) personality, 2) scholastic record—upper portion of class, 3) indicated promise of development in certain field, 4) some experience, 5) evidence of ability to cooperate with others, 6) indicated promise of executive development, 7) standing of college from which you have graduated, 8) recommendations from qualified persons, 9) salary question.

Good men are hard to find and harder to keep. The most common causes for discharge are as follows: Lack of specific skill or knowledge, 10% personality characteristics or traits, 90%. The most common causes for the prevention of promotion are as follows: Lack of specific skills, 25% personality traits, 75%. This is not a hopeless situation, however, since human beings can change, or acquire desirable personality traits. The key to success, therefore, is 40% technology and 60% diplomacy.

What sort of work does a graduate engineer do when he starts on a job? First, the engineer needs practical experience before he does the work he eventually wants to do. This means he might start as a manual laborer, a draftsman, a records clerk, etc. Many firms start the engineer as an aide, requiring him to attend courses offered by the firm; they then place him in a position for which he is best suited.

How long does a graduate work before getting a position of responsibility? This varies with the individual and the firm for which he works. Usually a man will work with a team on the staff. He demonstrates his ability and receives less and less supervision until he eventually starts making own decisions. Exceptional men do this in 2 to 3 years, the average takes 5 years.

What kind of salary should a professional engineer expect to receive? The salaries of engineers are well above the average of other workers. Money, however, is not the most rewarding part of engineering. Rather, it is the satisfaction received by doing this type of work that is more important. Engineers in manufacturing are broken down as follows: Civil, 8%; Electrical, 37%; and Mechanical, 69%. (Obviously, there is some overlapping of fields.)

The next speaker of the forum was Mr. E. J. Stocking, Assistant to Chief Examining Division, U. S. Civil Service Commission. His topic was "Civil Service for the Engineer."

The requisites for a good engineer are: basic knowledge of sound training, initiative, ability, plus integrity. There are countless possibilities of worthwhile engineering in the Government, and the Government has need for all types of engineers. Every phase of engineering is practiced in either the Federal, Municipal, or County Governments. The Government offers engineers security and a career or an opportunity for continuity of employment. There is an opportunity for development and research. Association with the Government is rewarding in that you become accepted by men of the profession.

Jobs in the Government are usually on competitive basis; however, in the lower grade jobs there is very little competition. The reason for this is that starting salaries are usually less than those in private industry. The question is, how much are you willing to sacrifice in salary in order to get into the work that you like? As you progress salary rates usually even out with those of private industry over the years.

We must keep in mind that Washington is not the only place in which the Federal Government operates, rather it is scattered throughout the United States and the world. Only 10% of its employees are located in the Washington area.

The third speaker was Mr. M. X. Wilberding, President of Wilberding Company, Inc. Mr. Wilberding discussed the question, "How to Become a Private Engineer?"

The first requirement is ethics—put service above yourself. There are no short-cuts to success in engineering. Second, knowledge; marks are not always indicative of what you know. During your college career, take a course you don't like. The reason: you may get a job to do that you won't like, therefore, this will be good training. Third economics. The private client has a budget and the private engineer must keep within that budget. He should know accounting, cost accounting, in particular, is most important. He should be familiar with tax regulations, the balance sheet, corporate law. He should know the English language—learn how to read, write and speak it well. Know how to write so that your client will understand scientific terms. Fourth, there is always a possibility that you may have to travel in foreign countries; know at least one other language. Fifth, you must know how to get along well with people; join civic and service clubs that make up part of the social community. Know the labor situation. The sixth requirement is security—private consulting is insecure. Most of the engineers live on a powder keg but most men grow to enjoy it. The seventh and final requirement is to know what you know. That is, know your capabilities and if you don't know something be honest enough to admit it and be able to recommend someone who does know.

The last speaker was Hr. H. H. Armsby, Chief for Engineering Education, Division of Higher Education, Department of Health, Welfare and Recreation. Mr. Armsby was clean-up man on the panel and summarized the engineering education.

The qualifications for engineers presented by Mr. Goetzenberger summarize the subject very well. The idea of knowing and using good English are equally important. The engineer should be able to write and speak so that he cannot be misunderstood. The manpower situation need not be reiterated. Thirty-thousand to 35,000 men per year are graduated from colleges in the United States and we need at least 40,000. Because there is such a shortage we must make the most of those that we have. Russia produces from 40,000 to 50,000 graduate engineers per year plus many technical school graduates.

Engineering is a profession with endless opportunities. Research and development provide for the production of new products, and therefore the creation of new jobs. Engineers can take the impossibility out of many things. The current average salary for a beginning engineer is about $373 per month.

But to the subject of engineering education, the question may be asked as to how to increase production of engineers. 1) Get a larger percentage of students in high schools to graduate. 2) Those graduates with good records should be encouraged to go to college (most common reasons for not going are financial or lack of interest). Vocational guidance in high schools and junior colleges, even junior high schools, is vital. 3) Colleges should give the best education possible. The Committee on Evaluation of Engineering Education is now evaluating standards to insure that future leaders in the field of engineering are getting the proper education. It is believed that less descriptive, applied courses and more humanistic courses together with a good solid background in mathematics and engineering fundamentals make up a good engineering program.

Some people feel that a good plan for national defense is to set up a reserve system of highly skilled engineers who could be called upon in time of need. The structure would be similar to that set up for the military and manpower reserves.

The engineer's job is a useful one. He is a builder of the world. The engineering mind is the type of mind that thinks straight and hard, that always tries to find the truth, that acts with courage to carry out the truth; it is of use to anyone in my profession; it can build motor cars or a nation.

A question-answer period followed.

The forum was adjourned at 10:30 p.m. by Chairman Rosen.

Stronger Concrete With Fly Ash

Arturo Y. Casanova III, B.C.E. '54

INTRODUCTION

At last there has been found a use for the precipitated ash that has been bothering the power plant engineer for many years. This ash, commonly called fly ash, is a by-product of combusion of powdered coal. In early power steam plants, the fly ash was allowed to pass out of the stack and settle over the country side, but with the advent of city ordinances to reduce the pollution of the air, the power plant engineer had to install electrostatic precipitators or other devices to collect the ash before it passed out of the stack. This, of course, presented the new problem of how to dispose of the ash. Usually, the ash was hauled to the plant dump or in some cases was "dumped" into the nearest river along with other industrial waste. This procedure was followed for many years with the result that most of the power plants had acres and acres of fly ash—at depths varying from twenty to sixty feet. The power plant engineer tried many uses for this by-products of combustion but all of these were to no avail. Upon a complete chemical analysis, it was found that fly ash was highly siliceous material with varying percentages of carbon. Since the silica content was so high, it was thought that fly ash could be classified as a pozzolan. (A pozzolan is any material, natural or artificial, which in the presence of lime and water will form a cementitious compound.) With the hydration of portland cement, calcium hydroxide is liberated. This contributes nothing to the strength of concrete and, therefore is easily leached out. When a pozzolan is present, it combines with the calcium hydroxide to form a new cementitous compound which will increase the strength of the concrete. As many pozzolans have been used to improve the quality of concrete, it was thought that fly ash would also improve it. The use of pozzolans in concrete is not new, as the Roman Aquaducts built 2000 years ago will prove. To make these aquaducts, the cement used was a volcanic ash or pozzolan and lime.

CHEMICAL

The principle constituent of fly ash is silica which usually constitutes about 45%. Other constituents are alumnina and iron oxides with traces of sodium and potassium oxides and sulphur troxide. There is usually a small percent of carbon in the fly ash as a result of poor combustion. Table (1) shows the variation of chemical composition of 35 fly ashes that were tested. Through practice it has been found the best results obtainable are usually with a fly ash of low carbon content.

Table 1

SiO_2	32.5 —51.9
Eg. Na_2O	1.39— 3.35
Carbon.	0.22—15.47
FE_2O_3	6.6 —20.3
CaO	1.2 —11.9
MgO	0.7 — 2.6
SO_3	0.18— 2.77
Loss on Ignition	1.0 —17.9
Specific Gravity	2.12— 2.69
Fineness (Blaine)	2430—5535 cm^2 gm.

PHYSICAL

The specific gravities of fly ash will vary depending on the percentages of iron oxides and carbon present. This fine powder has a fineness, by the Blaine Apparatus, varying from 2430 to 5535 cm^2/gm. The fineness is an important feature because the finer the fly ash is, usually a better pozzolanic action will result.

As shown in Table (1) fly ashes have varying chemical and physical properties, therefore each fly ash must be laboratory tested before it can be used for a concrete design mix. For the past two years, the writer has been conducting research on the effect of fly ash on the compressive strength of cement mortars. As the results will clarify the resulting increase in strength, the test procedure will be described.

MATERIALS

Thirty-five fly ashes were submitted from various parts of the Eastern section of the ciuntry. Although all thirty-five were tested, the results of only three will be given. The three selected are an apparently good fly ash, a fair fly ash and a poor fly ash. As can be seen by Table (2) "a" and "b" have about the same carbon content while "c" has a very high carbon content. Sample "c" will be used to demonstrate the effect of carbon on the mortar mix. Table (2) shows that "a" and "b" are about the same in all items with the exception of the fineness which varies about 1300 cm²/gm. As for sample "c", it is easily seen that its properties vary quite a bit.

Table 2

C	0.2	0.6	11.2
SiO_2	47.1	49.2	38.5
Fe_2O_3	19.2	16.2	18.8
SO_3	2.8	2.7	0.6
Loss on Ignition	1.2	1.2	11.6
Fineness	3075	4305	3220

SCOPE OF TESTS

In the laboratory tests, each fly ash was used to replace 10, 20, 35 and 50 percent of the cement by weight. With each sample a standard mix was made with 0 perecnt of fly ash.

The mixing of the compression cubes was made in accordance with ASTM Standard method (C109-50) using a nine cube batch. The W/C ratio was regulated so a flow of 100 to 115% in 25-½" drops was obtained on the standard flow table. After 24 hours storage in a moist closet at 96 percent humidity, the cubes were removed from their molds and placed in sealed copper containers at 72° F for testing at 28 days, 91 days and 365 days. At the test dates, three cubes of each batch were tested.

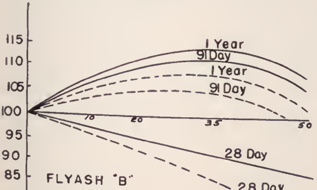

Fig. 1 — Compressive strength use. Fly Ash replacement curves for sample B. (Dashed curves denote low alkali cement.)

As the results of early tests showed that the strength of the fly ash mortar varied inversely as the C_3S content of the cement, a supplemental test was made to investigate the effect of cemen alkali content on pozzolanic action of the fly ash. This test was made with a high alkali and low alkali cement with the addition of 0.8 percent and 2 percent of sodium hydroxide added to the mix. The fly ash replaced 20 percent of the amount by weight.

TEST RESULTS

The resulting compressive strengths of the mortars with varying percentages of fly ash were compared with the strength of the batch with 0 percent fly ash and the results were expressed as a percentage of the standard.

Figure 1 gives the results of "b" with the use of various percents of fly ash with cement at 28, 91 and 365 days. As would be expected, the 28 days strength is lower than the standard for all percentages of replacement. These lower ratios can be explained by the fact that the cementing qualities of the fly ash had not begun to develop at this early age. The 91 days and 365 days strength show that the maximum strength of the fly ash cement is reached at about 35 percent replacement. It is interesting to note that after 40% replacement, the strength ratios drop rapidly. This data indicates that all percentages of fly ash up to 50% may be used without appreciable reduction of compressive strength at one year. It can be assumed that at later dates the strength ratio percentages would increase.

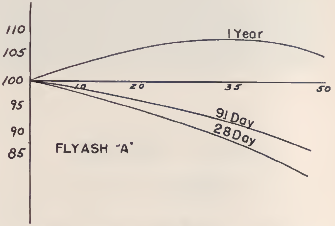

Fig. 2 — Compressive strength curves for sample A.

Figure 1 also gives the results of the use of the low alkali cement (dashed line). As can plainly be seen, with the lower alkali cement the strength ratio are greatly decreased. As a result of this data, additional tests were

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(Continued from page 11)

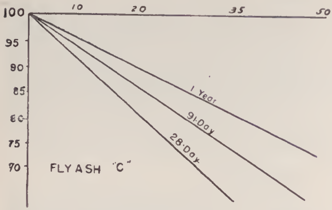

Fig. 3 — Results of replacement of fly ash C with varying percents of cements.

done on the effect of the alkalis of cement on the pozzolanic reaction.

Figure 2 gives the results of fly ash "a" with various percents of by ash used. As can be seen by these results, the pozzolanic reaction did not start to take effect until after the 91 days strength. This fly ash gave much lower strength ratios at all ages which can be attributed to the fact that his fly ash was a much coarser fly ash than "b" even though the carbon content was as low. The data of this test indicates that this fly ash may be used to substitute up to 35 percent without reduction of the strength at one year. Replacement of cement over 45 percent would never be acceptable.

Figure 3 shows the results of replacement of fly ash "c" with various percents of cement. As can be seen, this fly ash will never reach the strength ratio for passage at any age. It is true that this fly ash had a high carbon content, but this was still used to show the results. The data clearly shows that this fly ash should never be used as a replacement of cement for the pozzolanic reaction to take place.

Figure 4 shows the comparative results of all three fly ashes.

It is possible that better results could be obtained in these tests if alkalies could be added that would go into solution more slowly, therefore, not interfering with the hydration of the cement but still aiding the pozzolanic action.

CONCLUSION

The tests reported herein for fly ashes from three different sources gave the following indications:

(1) That fly ashes with less than 10% carbon, when substituted for a percentage of portland cement by weight in cement mortar caused a reduction in the compressive strength at 28 days. This would indicate the pozzolanic reaction of the fly ash does not begin at an early age.

(2) That a low carbon is necessary, and as the fineness increases apparently the pozzolanic reaction of the fly ash increases. This would indicate that the best fly ash would have a low carbon content and a high fineness.

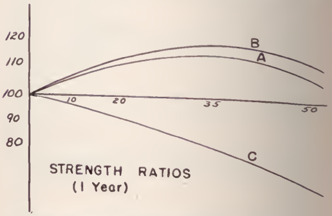

Fig. 4 — Comparative results of all three fly ashes.

(Please turn to page 20)

Brig. General David Sarnoff, Chairman of the Board, Radio Corporation of America

Sees No. 1 wish come true!

Television Tape Recording by RCA Opens New Era of Electronic Photography

In 1956, RCA's General Sarnoff will celebrate his 50th year in the field of radio. Looking ahead to that occasion, three years ago, he asked his family of scientists and researchers for three gifts to mark that anniversary: (1) A television tape recorder, (2) An electronic air conditioner, (3) A true amplifier of light.

Gift No. 1—the video tape recorder—has already been successfully demonstrated, two years ahead of time! Both color and black-and-white TV pictures were instantly recorded without any photographic development or processing.

You can imagine the future importance of this development to television broadcasting, to motion pictures, education, industry and national defense. And you can see its entertainment value to you, in your own home. There the tape equipment could be used for home movies, and—by connecting it to your television set—you could make personal recordings of your favorite TV programs.

Expressing his gratitude for this "gift," Gen. Sarnoff said it was only a matter of time, perhaps two years, before the finishing touches would bring this recording system to commercial reality. He described it as the first major step into an era of "electronic photography."

Such achievements as this, stemming from continuous pioneering in research and engineering, make "RCA" an emblem of quality, dependability and progress.

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ENGINEERING PERSONALITIES

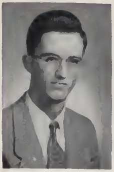
Forest K. Harris

Doctor Forest K. Harris, Professional Lecturer in Electrical Engineering, member of the Graduate Advisory Committee, received his A.B. and M.S. degrees from Oklahoma University and his Ph.D. from Johns Hopkins University. He is a member of Sigma Tau, Sigma Xi, Phi Beta Kappa, the Cosmos Club, the Washing Academy of Science and the American Institute of Electrical Engineers. In the latter he has served on several AIEE National Committees. He is presently Associated Editor of the, **Review of Scientific Instruments,** and in addition is the author of the book, **Electrical Measurements.**

Precisely in what manner all the foregoing allows him any time for hobbies is somewhat of a mystery, but he still finds time to pursue his interest in music. This year he started a rose garden, a project which he says he dreams about in technicolor. Furthermore he is an amateur chef, although he expresses some doubt as to whether this should be classified as a hobby.

(Please turn to page 18)

John Dodge



John Dodge's record at The George Washington University provides factual evidence that engineering students of today are dynamic, sociable, civic minded people. During John's four years at George Washington University, he has become a vital component of many campus organizations. This year, in recognition of his many contributions, he was selected for "Who's Who in American Universities and Colleges." Few students have ever deserved the honor more.

Despite John's association with many and varied organizations, he never loses sight of the fact that his basic purpose in school is to obtain an education in electrical engineering. He will graduate high in his class and he has long been a member of the engineering honorary scholastic society, Sigma Tau. He will

(Please turn to page 19)

Another page for **YOUR BEARING NOTEBOOK**

Jet's wheel bearings have to take three kinds of forces

When the F86-D Sabre Jet lands—the wheel bearings take a triple beating. There's the initial landing shock, an almost instantaneous acceleration; and, if there's a crosswind, heavy thrust loads. Bendix and North American solved this triple punch problem by using Timken® tapered roller bearings for all three landing wheels. Their tapered design enables them to take radial and thrust loads in any combination. And Timken bearings' true rolling motion and incredibly smooth surface finish practically eliminate friction permitting rapid acceleration.

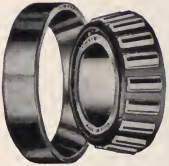
Line contact helps TIMKEN® bearings take jet landing load

This cross-section drawing shows one reason Timken bearings are ideal for taking the heavy landing load of the plane itself. Note the full line of contact between rollers and races. This gives Timken bearings high load capacity. It's a basic advantage of roller bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

NEWS AND VIEWS

SIGMA TAU INITIATES, PICKS NEW SLATE

On Saturday, April 17, thirteen men were initiated into Xi Chapter of Sigma Tau. The new brothers are as follows: D. A. Bucci, T. J. Creswell, C. P. McCall, H. L. Baker, H. L. Bass, G. F. Rowe, N. L. Van Kleek, W. A. Weidemeyer, A. J. Wedler, E. A. Painter, P. M. Douglas, C. F. Mohl, and S. A. Mawhood. Also at this time the new officers were installed. The administration now consists of Al Parks, President; Kingsley Brown, Vice President; Robert Little, Treasurer; Stanley Vest, Recording Secretary; Eric Enholm, Corresponding Secretary; and Leon King, Engineers' Council Representative.

These events were celebrated that evening at the Brook Farm Restaurant, where alumni and actives met for a superb banquet and dance.

THETA TAU ELECTS OFFICERS

Gamma Beta chapter of Theta Tau Fraternity has elected the following officers for the coming year: Bill Weidemeyer, Regent; Bob van Sickler, Vice-Regent; Kingsley Brown, Scribe; Matt Foster, Treasurer; and Harry Brandler, Engineering Council Representative.

The chapter held a stag smoker Saturday April 24 at the Delta Tau Delta House in honor of the prospective pledges. Next week the brothers will be host to their National Grand Regent Jamison Vawter. A banquet is planned to celebrate his visit. All alumni are invited to attend the fete.

MECHELECIV STAFF TAPPED

The George Washington University Chapter of Pi Delta Epsilon, national journalism honorary, initiated three members of the MECHELECIV staff last Saturday.

The new engineering members of the honorary are Bob van Sickler, Leon King, and Sam Mawhood. Membership is elected on the basis of achievement on behalf of the publications of the University.

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FOREST K. HARRIS

(Continued from page 16)

Dr. Harris' son is a George Washington University graduate in chemistry and medicine and he will be a Resident in Medicine at the D. C. General Hospital next year. These facts make it appear that he is a chip off the old block, something of which his father may rightfully be proud.

One of the most interesting jobs Dr. Harris ever participated in was the development of an electrical method for making small diamond dies for drawing wire. The group developed an electrolytic erosion process for piercing the diamond and shaping the contour of the die surface. This results in better, longer wearing dies, and in addition it has reduced the amount of hand work by a factor of ten or greater. This group produced dies with openings as small as 0.0003 in. in diameter. Practically all dies, both here and abroad, are now made by this process.

Dr. Harris is the embodiment of the traditional policy of the School of Engineering of appointing to the faculty engineers who are outstanding in their profession and who are familiar with present day engineering problems.

JOHN DODGE

(Continued from page 16)

graduate this June at the age of 21.

Outside of Engineering, John's greatest interest lies in the George Washington Sailing Team. He has been a member of the team for the last four years, and has been the Captain for the past two years. His ability with the Tempest Class dinghies has helped bring many trophies to GWU. In the March Beer Mug Regatta with Princeton which GWU won, John was high scorer with 32½ points out of a possible 36⅓.

In addition to the sailing club, John has been a member of the Institute of Radio Engineers for the last four years. During the past three years, he has served that organization as Secretary.

In 1952, he was selected by Theta Tau, an engineering organization that stresses practibility and sociability as prerequisites for membership. During his Junior year, Sigma Tau tapped him in recognition of his superior scholastic record. And finally, in this his last semester, he was elected to Omicron Delta Kappa, a fraternity emphasizing leadership in extracurricular activties, and the ultimate in campus recognition.

John is a native of the Washington area and presently lives with his parents in Arlington, Virginia. He has been fortunate to be able to finish his college education without any service interruption; however, it is very possible that the draft board will seek him out upon graduation. With this in mind, John has not made any final plans for the immediate future.

Alums! Your subscription is very important, as we explained last issue. If you haven't done so already, fill out the form below and return with your subscription fee. Please, also, let us have news of yourself and comments on Mechelecív.

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Enclosed is check for $2.00 for my subscription to Mechelecív for the calendar year 1954.

Comments --

STRONGER CONCRETE WITH FLY ASH

(Continued from page 14)

(3) In all cases tested, fly ash becomes beneficial with age..

(4) That a good fly ash can replace from 15% to 35% of portland cement in cement mortar and give better and stronger mortar at future dates.

Fly ash-mortar made with 20 to 35 percent fly ash by weight, is stronger, at later stages of curing and aging, than mortar made without fly ash. This is due to the cementitious compounds formed by the pozzolanic action of the fly ash. This in itself is a great stride forward in cement research. This stride forward along with the economical aspects of fly ash, opens a new road for concrete construction.

NEWS AND VIEWS

(Continued from page 18)

CE Production Planning

CE Bill Weidemeyer, in cooperation with his wife, Lucy, has just become the proud father of a seven pound, eight ounce baby girl. Kristie Weidemeyer was born Saturday April 17, during the Easter Holidays, so her father would not miss any classes. This is a good example of production planning.

Something New In ME Lab

The ME lab in Corcoran Annex is now the scene of a new project and much interest on the part of the students.

In answer to many queries, the MECHELECIV has discovered that the twenty-foot long plumbing masterpiece is the partially completed, portable weir tank being constructed by the Civil Engineering Department.

This portable tank, when completed, will be moved on four casters to a destination yet unknown.

AIRE IRE

On Wednesday night, April 6, 1954, the Joint Branch AIEE-IRE had their annual elections for the 1954-55 school year. Harry M. Brandler was elected chairman, L. H. King was elected vice-chairman, M. Brady was elected secretary, and W. Crockett was elected treasurer. Prof. Ames was appointed advisor for the AIEE's, and Prof. Abraham was appointed advisor for the IRE's.

A father and his young son who carefully held in his lap a shoe box punctured with air holes, were seated in a bus. When the bus stopped for a red light, the lad was heard to ask, "Daddy, is my kitten a man kitten or a lady kitten?"

"A man kitten," said the father promptly.

"How do you know?" the boy continued.

Every passenger within earshot waited expectantly for the reply.

"Well," explained the father, "he's got whiskers, hasn't he?"

ATTENTION!

WOMEN ENGINEERING STUDENTS

Please contact:

Lt. Ruth Carolyn White
Chairman, Washington Section
Society of Women Engineers

Address:

3711 Benton Street, N.W.
Washington, D. C.

if interested in becoming a member of the Society.

Richmond Station of the Philadelphia Electric Co.

Weeks of work shrink to days as photography weighs mountains of coal

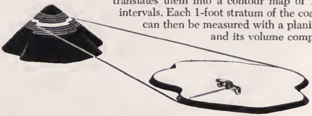
Aero Service Corporation takes stereo pictures of the coal piles at a utility's 10 storage sites—reports the fuel reserves on a single inventory date at 25% lower cost than with other methods

It used to take a surveying crew weeks to measure and figure the contents of the Philadelphia Electric Co.'s big coal piles. Now a camera and an airplane work together to cut the time to days. Overlapping pictures are taken from the air. Then with stereo plotting equipment the volume of the heap is calculated.

Streamlining the inventory job is a natural for photography. It's being used to count metal rods, automotive parts, telephone calls as well as tons of coal. But photography works for business in many other ways as well—saving time, reducing error, cutting costs, improving production.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Aero Service Corporation takes its stereo photographs and translates them into a contour map of 1-foot intervals. Each 1-foot stratum of the coal pile can then be measured with a planimeter and its volume computed.



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